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RDT&E PROJECT NO. 1M643303D548

USATECOM PROJECT NO. 7-3-0171-02

ENGINEERING TEST OF MEAL, UNCOOKED, 25-MAN

FINAL REPORT

BY

HUNTER H. PASCHALL

OCTOBER 1966

U S ARMY
GENERAL EQUIPMENT TEST ACTIVITY
FORT LEE, VIRGINIA

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RDT&E PROJECT NO. 1M643303D548

USATECOM PROJECT NO. 7-3-0171-02

ENGINEERING TEST OF MEAL, UNCOOKED, 25-MAN

TEST REPORT

BY

HUNTER H. PASCHALL
Engineering Test Directorate

OCTOBER 1966

U.S. ARMY
GENERAL EQUIPMENT TEST ACTIVITY
FORT LEE, VIRGINIA

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DEPARTMENT OF THE ARMY
HEADQUARTERS, U. S. ARMY TEST AND EVALUATION COMMAND
ABERDEEN PROVING GROUND, MARYLAND 21005

AMSTE-GE

6 DEC 1966

SUBJECT: Approved Final Report of Engineering Test of Meal Uncooked,
25-Man, USATECOM Project No. 7-3-0171-02

TO: Commanding General
U. S. Army Materiel Command
ATTN: AMCRD-DM-E
Washington, D. C. 20315

1. References:

a. Letter, U. S. Army Natick Laboratories, file AMKRE-FPC, dated 5 February 1965, subject: "Engineering/Service Test of Meal, Uncooked, 25-Man."

b. Letter, U. S. Army Test and Evaluation Command, file AMSTE-GE, dated 17 February 1965, subject: "Test Directive, USATECOM Project No. 7-3-0171-02, Engineering Service Test of Meal, Uncooked, 25-Man, DA Project No. 1M643303D548."

c. Unclassified message, USAMC 22964 from AMCRD-DM-E, subject: "Special Study of Meal Uncooked, 25 Man; Packet, Subsistence, LRP and "M" Packet in Viet Nam."

d. Letter, U. S. Army Test and Evaluation Command, file AMSTE-GE, dated 7 October 1966, subject: "Approved Final Report of Special Study of Meal, Uncooked, 25-Man; Packet Subsistence, Long-Range Patrol; and "M" Packet in Viet Nam, USATECOM Project No. 7-6-0697-01."

e. USATECOM Project No. 7-3-0171-02, Final Report of Engineering Test of Meal Uncooked, 25-Man, October 1966.

2. As indicated by reference 1a, subject project was initiated as an Engineering/Service Test. At the direction of US Army Materiel Command, reference 1c, the service test portion of the meals were sent to Viet Nam for evaluation. Report of findings in Viet Nam are reflected in reference 1d. As a consequence, the inclosed report only covers the engineering test portion of the originally directed engineering/service test. As a further consequence, this final report terminates USATECOM Project No. 7-3-0171-02, reference 1b.

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6 DEC 1968

SUBJECT: Approved Final Report of Engineering Test of Meal Uncooked,
25-Man, USATECOM Project No. 7-3-0171-02

3. The conclusions reflected in reference 1e are as follows:

a. Except for the shortcomings cited, the technical performance and design of the current 18 menus of the Meal, Uncooked, 25-Man are considered satisfactory for their intended purpose.

b. There are no safety hazards involved in the preparation and use of the Meal, Uncooked, 25-Man; however, further evaluations should be conducted in conjunction with the Office of The Surgeon General to determine the suitability of the meal for use as the sole diet over indefinite periods in excess of 30 days.

c. The Meal, Uncooked, 25-Man is suitable for service test.

4. The recommendations reflected in reference 1e are as follows:

a. The current 18 menus of the Meal, Uncooked, 25-Man be considered suitable for service testing when as many as possible of the shortcomings have been corrected.

b. Action be initiated for the development of the 12 additional menus necessary to complete the 30 menus as required by paragraph 2b of the Technical Characteristics.

c. Studies and evaluation be made of the 30 menus in conjunction with the Office of The Surgeon General with respect to monotony, variety, and physiological effects when consumed over a period of a year as a sole diet.

d. The final prototype (30 menus) be returned to the U. S. Army General Equipment Test Activity for appropriate engineering/service testing.

5. Conclusions:

a. The Meal, Uncooked, 25 Man is suitable for service test after shortcomings are corrected.

b. Further evaluation should be conducted to determine suitability for use as a sole diet for indefinite periods in excess of 30 days.

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6 DEC 1963

SUBJECT: Approved Final Report of Engineering Test of Meal Uncooked,
25-Man, USATECOM Project No. 7-3-0171-02

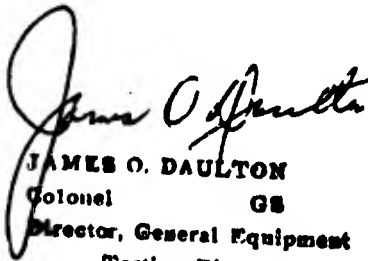
6. Recommend the Meal, Uncooked, dehydrated, 25-Man, be engineering/
service tested after existing shortcomings have been corrected and the full
compliment of menus is available.

FOR THE COMMANDER:

1 Incl
as (USAMC - 5 cys)

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JAMES O. DAULTON
Colonel GS
Director, General Equipment
Testing Directorate

**U. S. ARMY GENERAL EQUIPMENT TEST ACTIVITY
FORT LEE, VIRGINIA**

USATECOM 7-3-0171-02

**Final Report of
Engineering Test of Meal, Uncooked, 25-Man**

Conducted at Fort Lee, Virginia

October 1966

Abstract

An Engineering Test of Meal, Uncooked, 25-Man was conducted from 1 June 1965 - 24 June 1966 by USAGETA to determine the technical performance and safety characteristics of the meal and to determine its technical suitability for service test.

Except for nine shortcomings discovered during testing, it was concluded that: the technical performance and design of the current 18 menus are considered satisfactory for their intended purpose; no safety hazards are involved in preparation and use of the meal, however further evaluations should be conducted to determine the suitability of the meal for use as the sole diet over indefinite periods in excess of 30 days; and the meal is suitable for service testing.

It was recommended that: the current 18 menus be considered suitable for service testing after as many as possible of the nine shortcomings are corrected; action be initiated for developing 12 additional menus to complete the 30 menus as required by the Technical Characteristics; studies and evaluation be made of the 30 menus in conjunction with the Office of The Surgeon General to determine the monotony, variety, and physiological effects when consumed over a 1-year period as a sole diet; and the final prototype (30 menus) be returned to USAGETA for appropriate engineering/service testing.

FOREWORD

The U.S. Army General Equipment Test Activity was responsible for preparing the test plan, executing the test, and preparing the test report. This test was originally scheduled as an Engineering/Service Test; however, this report pertains to the Engineering Test phase only since the Service Test phase was suspended due to the nonavailability of support troop units and the use of the ration in Vietnam as part of a Special Study (USATECOM Project No. 7-6-0697-01).

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SECTION 1. INTRODUCTION

1.1 BACKGROUND

The Meal, Uncooked, 25-Man, is part of a developmental simplified combat feeding system comprising three types of packaged meals (Quick Serve Meal; Meal, Ready-to-Eat, Individual; and Meal, Uncooked, 25-Man) which commanders can use interchangeably depending on prevailing tactical and logistical conditions. Research and development to establish this system began in 1955. Since then the Quick Serve Meal (6- and 25-man modules), designed to feed small dispersed groups where food service personnel and preparation facilities are not available, has undergone temperate and arctic engineering-service tests and tropical service evaluation (Ref. 1 and 2, App. IV). Three menus of the Meal, Ready-to-Eat, Individual, designed for issue to individuals under situations which preclude utilization of the Quick Serve Meals, have undergone engineering test (Ref. 3, App. IV) and engineering/service test of 12 menus of this meal is scheduled for FY 1967.

This test involved the third type of packaged meals of the simplified combat feeding system -- Meal, Uncooked, 25-Man. This meal is designed as the eventual replacement of the Standard "B" Ration and is intended for normal large-group operational feeding of all elements of the field Army in those situations prescribing its use except when prohibited by the tactical situation. Its use will be dependent upon establishment of normal resupply, availability of food service equipment and trained mess personnel, and supplementation of the menus with bread and cake. Previous engineering test results of nine menus of this meal (Ref. 4, App. IV) showed that the meals met all of the Military Characteristics for which they were tested. Additional components, recipes, and preparation methods have been developed and 18 menus, six each of breakfast, dinner, and supper, were available for the current test. It is planned that the Meal, Uncooked, 25-Man will ultimately provide 30 menus, 10 each of breakfast, dinner, and supper, for use on a 10-day cycle.

1.2 DESCRIPTION OF MATERIEL

The experimental Meal, Uncooked, 25-Man (Fig. 1) consists of 18 menus, six each of breakfast, dinner, and supper. Each menu consists of factory-assembled, nonperishable foods packaged in a 25-man module,

making maximum use of dehydrated foods and lightweight packaging. Each menu is a complete meal except for supplementation of bread and cake which are provided separately as appropriate. The average gross weight of each case of the 25-man meal is approximately 18.8 pounds with an average volume of 0.82 cubic feet. Each of the major food components is packaged in plastic-foil-plastic laminated bags or pouches, and overpacked in a solid fiberboard carton. The components of each menu are packed in a W5c corrugated fiberboard box, and sealed with tape. This container is then overpacked in a V3s solid fiberboard shipping case. The ends of the cases are sealed with glue and each case is bound with either one or two wire bands depending on the size of the case. Preparation instructions for specific menu items are given on unit package labels and a Menu Information and Schedule Sheet (Fig. 2) is included in each case.

1.3 TEST OBJECTIVES

To determine the technical performance and safety characteristics of the Meal, Uncooked, 25-Man, as described in the Military and Technical Characteristics, and as indicated by the particular design, and to determine the technical suitability of the item for service test.

1.4 SUMMARY OF RESULTS

a. The extent to which the Meal, Uncooked, 25-Man met those Military and Technical Characteristics pertaining to nutritional adequacy and effects of long term feeding was not determined (Par. 2.7).

b. The safety characteristics of the Meal, Uncooked, 25-Man were adequate from the standpoint of preparation and serving.

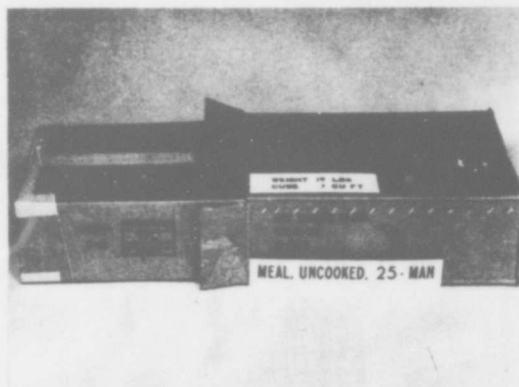
c. The Meal, Uncooked, 25-Man satisfactorily met the requirements of all other Military and Technical Characteristics (App. II) except for the following shortcomings:

(1) The suggested preparation time schedule, shown in the Menu Information and Schedule Sheet, was not realistic and was misleading (Par. 2.3.4 and Table III).

(2) The quantity of strawberries was insufficient for adequate servings (Par. 2.3.4).



Meal case intact.



Meal case showing inner container.



Single menu showing components.

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NEGATIVE 6, 5, 2

Figure 1. Meal, Uncooked, 25-Man identification.

Pork Chops
50 Chops

Seasonings

Recipe for Breaded Pork Chops
25 Servings, 2 chops each

Pork Chops, dehydrated
Water 100%
Salt (1 ounce)
Breading Mix (1 pound)
Seasoning Mix, Type II (2 ounces)
Margarine (6 ounces)

1 pkg.
4 quarts
1 pkg.
1 pkg.
2 pkg.
1-1/2 sticks

Open bag containing chops on one side and leave in carton.
Sprinkle salt over chops.
Add water to cover chops.
After 20 minutes, check chops for complete rehydration.
If there are hard spots, prick chops with a fork and soak 10 minutes more.
Drain chops.
Mix seasoning with breading mix.
Roll chops in breading, place on cake pan until cooking time.
Cover and hold in cool place.
Heat margarine in griddle.
Cook breaded chops until lightly browned, about 1 minute per side.
Do not overcook.
Serve with cream gravy.

Recipe affixed as Unit Package Label.

Menu Information and Schedule
Meal, Uncooked, 25-Man
Dinner No. 6

Menu:

Breaded Pork Chops
Cream Gravy
Mashed Sweet Potatoes
Green Beans with Bacon
Bread from Field Bakery
Margarine Jelly (25 pgs)
Applesauce Oatmeal Cookies
Coffee Tea (5 pgs)
Cream (25 pgs) Sugar (50 pgs)

Water Requirements: 3 1/2 gallons cold water 4 gallons boiling water

Schedule: The following schedule is suggested for preparation, but should be adjusted for individual situations. Prepare food according to package label using available kitchen equipment and applying good food service practices in sanitation holding, and serving meal.

<u>Time before serving</u>	<u>Item</u>	<u>Cold water</u>	<u>Boiling water</u>
1 1/4 hours	Heat water.		(16 qts)*
	Soak pork chops.	4 qts.	
	Mix cookies.	1 cup	
1 hour	Make cookies.		
	Start green beans.	4 qts.	
	Drain chops.		
	Season and bread chops.		
3/4 hour	Cut margarine.		
	Make applesauce.	3 qts.	
	Arrange self-service items.		2 qts.
1/2 hour	Mix sweet potatoes.		
	Grill chops.		
1/4 hour	Make gravy.	2 qts.	
	Make coffee.		13 qts.
	Water for tea.		1 qt.

Menu Information and Schedule Sheet.

Figure 2. Typical Recipe and Menu Information and Schedule Sheet for Meal, Uncooked, 25-Man.

- (3) Some recipes were inaccurate (Par. 2.3.4 and Table V).
- (4) The margarine melted at temperatures above 98°F. and was therefore only marginally suitable as a spread under these conditions (Par. 2.3.4). At 104°F., it was unsuitable as a spread.
- (5) The chocolate chips for cookies melted at temperatures above 98°F. (Par. 2.3.4).
- (6) Jelly leaked at the seals and at the wall-seal junction of the packages, and its consistency was too thin (Par. 2.3.4).
- (7) The cases were difficult to open due to the lack of a suitable tool for cutting wire banding material (Par. 2.4.4).
- (8) As constructed, the shipping container and the individual packages did not provide maximum protection against water penetration (Par. 2.4.4).
- (9) The quantity of aluminum baking pans as currently authorized for the field kitchen was inadequate for preparing 6 of the 18 menus (Par. 2.5.4).

1.5 CONCLUSIONS

- a. Except for the shortcomings cited, the technical performance and design of the current 18 menus of the Meal, Uncooked, 25-Man are considered satisfactory for their intended purpose.
- b. There are no safety hazards involved in the preparation and use of the Meal, Uncooked, 25-Man; however, further evaluations should be conducted in conjunction with the Office of The Surgeon General to determine the suitability of the meal for use as the sole diet over indefinite periods in excess of 30 days.
- c. The Meal, Uncooked, 25-Man is suitable for service test.

1.6 RECOMMENDATIONS

It is recommended that:

a. The current 18 menus of the Meal, Uncooked, 25-Man be considered suitable for service testing when as many as possible of the shortcomings have been corrected.

b. Action be initiated for the development of the 12 additional menus necessary to complete the 30 menus as required by paragraph 2b of the Technical Characteristics.

c. Studies and evaluation be made of the 30 menus in conjunction with the Office of The Surgeon General with respect to monotony, variety, and physiological effects when consumed over a period of a year as a sole diet.

d. The final prototype (30 menus) be returned to the U. S. Army General Equipment Test Activity for appropriate engineering/service testing.

SECTION 2. DETAILS OF TEST

2.1 INTRODUCTION

Testing was conducted at Fort Lee, Virginia, during the period 1 June 1965 to 24 June 1966. This test involved the use of both subjective and objective testing techniques and methodology. The experimental menus were evaluated under simulated normal use conditions to obtain measures of such factors as performance, utility, compatibility with currently authorized field kitchen equipment, durability of cases and packages, and other functional characteristics. Data obtained were used to determine the extent to which the test item met the Military and Technical Characteristics and its suitability for service test. Individual tests performed are described in subsequent paragraphs of this report.

Measures of troop acceptability of the Meal, Uncooked, 25-Man, were not obtained as this phase of the test was not conducted because supporting troop units were unavailable. However, an evaluation of the acceptability of the meal in Vietnam was made as part of a Special Study and reported under USATECOM Project No. 7-6-0697-01.

2.2 CONFIGURATION

2.2.1 Objectives

To determine that:

a. Each packaged meal is of minimum weight and bulk and that the gross weight does not exceed 25 pounds.

b. The ration is packaged on a meal basis for 25 men exclusive of bread and cake.

c. The ration cases are compatible with standard storage pallets.

2.2.2 Method

Fifteen cases of each menu, exclusive of bread and cake, were randomly selected for weight and volume measurements. Cases were weighed on calibrated scales and volume measurements were taken. The

weight and volume for each case so obtained, along with the weight and volume as shown on the respective cases, were recorded. While bread and cake for use with the Meal, Uncooked, 25-Man are to be provided separately, the increase in weight and volume which would result if the mix for these items were packaged in appropriate menus were computed and recorded.

Observations were made to determine if all menus were packaged on a meal basis for 25 men, exclusive of bread and cake. Cases of each menu were stacked on standard 40- by 48-inch pallets to determine the suitability of the cases for palletizing.

2.2.3 Results

The actual average weight of the 18 menus, exclusive of bread and cake, was 18.8 pounds which is 0.2 pound greater than the average weight as shown on the meal cases. The actual average volume of the 18 menus was 0.82 cubic feet which is 0.13 cubic feet greater than the average volume as shown on the meal cases. Data pertaining to the weight and volume of each menu, exclusive of bread and cake, are shown in Appendix I-A. Shown in Appendices I-B and I-C, respectively, are data pertaining to the weight and volume of each menu with the inclusion of bread and cake mixes in the meal case.

The weight and volume for required quantities of bread and cake mixes, as appropriate for each module, was 56 ounces of bread mix and 40 ounces of cake mix with a computed volume of .096 and .067 cubic feet, respectively. Bread is required for all menus and cake is required for menus D-1, -3, -4, S-5, and -6.

All meals prepared showed that the test item was packaged on a meal basis for 25 men and that each case contained all food components except bread and cake for a specific menu. Shown in Table I are data pertaining to the 6 different sizes of cases used in packaging the 18 menus and the number of cases for each size case that can be placed on standard storage pallets.

2.2.4 Analysis

The average actual weight per case was slightly more (.2 pounds) than the average weight as recorded on the case. In no instance however,

TABLE I

SIZE OF CASES USED IN PACKAGING MEAL, UNCOOKED, 25-MAN
BY MENUS AND NUMBER OF CASES PER STANDARD PALLET

Size of Case*			Menu	No. Cases Per Layer on 40- by 48-Inch Pallet	Optimum No. Cases Per Pallet**
Width	Height	Length			
11 1/8	5 3/4	16 5/8	B-1, -3, D-4	8	80
12 1/8	5 3/4	16 5/8	B-2, D-3	8	80
9 7/8	5 3/4	16 5/8	B-4, -5, -6, D-1	10	100
10 5/8	8 3/4	15 5/8	D-2, S-1, -3, -4, -5	9	54
13 1/2	5 3/4	16 5/8	D-5, -6, S-6	6	60
10 3/4	10 5/8	16 5/8	S-2	8	40

*Dimensions expressed in inches.

**Based on a pallet height of approximately 54 inches.

did the actual weight per case exceed the 25-pound limitation imposed by the Military and Technical Characteristics. The volume as recorded on each meal case was based on the dimensions of the unfilled outer (shipping) container; however, when the outer container was filled with the inner container and the individually packaged menu components, there was slight bulging at both ends of the shipping container and the end flaps did not close properly because the inner container was too large (Fig. 3). As a result, the actual volume was 0.13 cubic feet more than the volume as recorded on the case. There was no observed waste of space within either the individual packaged menu component packages or in the meal cases. Also, the volume of the meal as packaged did not interfere in any way with the handling or use of the item. On this basis, the Meal, Uncooked, 25-Man is considered adequate with respect to the requirement specified in the Military Characteristics that the packaged meal shall be of minimum bulk consistent with other requirements.

The Meal, Uncooked, 25-Man meets the requirements of the Military and Technical Characteristics with respect to its being packaged as a meal for 25 men, exclusive of bread and cake. Further, the cases are compatible with standard 40- by 48-inch pallets.



Improper closure
(moderate).



Improper closure
(extreme).

Figure 3. Typical improper closures of
shipping cases.

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Should it be considered appropriate to include bread and cake mixes in the menu cases with the other components, the inclusion of bread mix would increase the average weight per module by 3.5 pounds (18.6 percent) while the inclusion of both bread and cake mixes would increase the average weight per module by 4.2 pounds (22.3 percent). The inclusion of bread mix would result in 3 menus (supper 1, 2, and 4) exceeding the 25 pounds per case weight limitation prescribed by Military and Technical Characteristics. The inclusion of both bread and cake mixes would result in 5 menus (supper 1, 2, 4, 5, and 6) exceeding the weight limitation. With regard to the effects on the average volume per module, the inclusion of bread mix would increase the volume by 0.10 cubic feet while the inclusion of bread and cake mixes would increase the volume by 0.12 cubic feet.

2.3 PERFORMANCE

2.3.1 Objective

To determine the accuracy of recipes, adequacy of preparation instructions, ease of preparation, and skill level required of food service personnel for the preparation of the meal.

2.3.2 Method

Two groups of students attending Food Service Courses at the Quartermaster School, Fort Lee, Virginia, participated in this phase of the test. One group consisted of skilled food service personnel in the grades of E-5 to E-7 with over 10 years of Army cooking experience, and who had completed formal food service courses. The other group of students consisted of unskilled food service personnel in the grades of E-2 to E-3 who had recently entered military service, were in the eighth (last) week of the Basic Cooks Course, and who had little or no prior cooking experience. All personnel were given a detailed orientation prior to the preparation of the first menu. Each group, divided into 3-man shifts, prepared 6 modules of each of the 18 menus under simulated field conditions using field messing equipment authorized by TM 10-701¹ for 150 men. Pertinent weather data for dates that the meals were prepared are shown in Appendix I-D.

¹Range Outfit, Field, Gasoline, M-1937 with Accessory Outfit.

Initially, each menu was prepared in accordance with the recipes and instructions contained in each meal case. A test team from GETA, consisting of a Food Service Supervisor and a test observer, was assigned to each field kitchen and was present during the preparation of each menu. No assistance was given to the cooks in the preparation of the menus unless, through observation, it was obvious that assistance was needed.

Data were recorded by the test team with regard to preparation time, water requirements, adequacy of equipment and instructions, quality of preparation, and related factors in the preparation of each menu. Immediately after preparing each menu, each cook completed a questionnaire pertaining to adequacy of instructions, recipes, and equipment, and ease of preparation as it applied to that specific menu. At the end of this phase of the test, all cooks completed a final questionnaire designed to obtain their overall opinion of the experimental meal.

2.3.3 Results

Shown in Table II is a summary of the water required in the preparation of 6 modules of each menu with a further breakdown of the quantity of water, in gallons, per person per menu and the average for all menus. A comparison of the overall average time required in the actual preparation of the meal with that as shown in the Menu Information and Schedule Sheet is shown in Table III. A summary of responses by participating food service personnel to specific questions pertaining to the preparation of the meal is shown in Table IV. Suggested changes to recipes are shown in Table V.

2.3.4 Analysis

a. Water Requirements

The total quantity of water as shown on the Menu Information and Schedule Sheet and by the recipes included in each case was essentially the same as that actually required in the preparation of the menus. Variations in the quantity of water required for specific menu components are shown in Table V. The average quantity of water, 0.28 gallons per person, used in the preparation of menus during this test compares favorably with the average quantity of water, 0.29 gallons per person, used during a previous test (Ref. 4, App. IV). It is noted that the quantity of water for

TABLE II

SUMMARY OF WATER REQUIRED IN
PREPARING MEAL, UNCOOKED,
25-MAN FOR 150 MEN (6 MODULES)

<u>Menu</u>	<u>Cold Water Required (qts.)</u>	<u>Hot Water Required (qts.)</u>	<u>Total Water</u>		<u>Water Per Person (gal.)</u>
			<u>Qts.</u>	<u>Gal.</u>	
B-1	43.50	117	160.50	40.25	.268
B-2	42.75	124.50	167.25	41.80	.279
B-3	36	108.50	144.50	36.12	.241
B-4	13.50	120	133.50	33.37	.222
B-5	51	103.50	154.50	38.62	.257
B-6	49.50	85.50	135	33.75	.225
D-1	3	120	123	30.75	.205
D-2	36	144	180	45.00	.300
D-3	53	118.50	171.50	42.87	.286
D-4	84	60	144	36.00	.240
D-5	60	105	165	41.25	.275
D-6	79.50	96	175.50	43.87	.292
S-1	54	160.50	214.50	53.62	.357
S-2	48	178.50	226.50	56.62	.377
S-3	23.75	163.50	187.25	46.81	.312
S-4	43.50	163.50	207	51.75	.345
S-5	42	130.50	172.50	43.12	.287
S-6	42	119.50	161.50	40.37	.269
AVG.	44.72	123.25	167.97	41.99	.280

TABLE III

COMPARISON OF AVERAGE TIME REQUIRED IN PREPARING
SIX MODULES WITH THAT SHOWN IN MENU INFORMATION AND SCHEDULE SHEET

<u>Menu</u>	<u>Scheduled time * for preparation</u>	<u>Average time * required</u>	<u>Additional time* required</u>
B-1	60	105	45
B-2	75	190	115
B-3	75	122½	47½
B-4	75	138½	63½
B-5	60	142½	82½
B-6	60	105	45
D-1	75	127½	52½
D-2	75	167½	92½
D-3	60	122½	62½
D-4	60	115	55
D-5	75	192½	117½
D-6	75	187½	112½
S-1	75	127½	52½
S-2	75	164	89
S-3	90	175	85
S-4	75	157½	82½
S-5	75	150	75
S-6	60	117½	57½

*All times are expressed in minutes.

TABLE IV
SUMMARY OF RESPONSES BY COOKS TO
SPECIFIC QUESTIONS PERTAINING TO MEAL, UNCOOKED, 25-MAN

Question	Response	Distribution	
		Skilled Cooks	Unskilled Cooks
1. Were the instructions for preparing the meal simple, adequate, and easy to follow?	Yes	58	54
	No	<u>5</u>	<u>1</u>
	Total	63	55
2. How easy or difficult was the preparation of the meal?	Very easy	41	27
	Moderately easy	17	20
	Slightly easy	1	4
	Slightly difficult	3	4
	Moderately difficult	0	0
	Very difficult	<u>1</u>	<u>0</u>
	Total	63	55
3. Do you consider the size of serving for each item as shown by the respective recipes to be:	Not enough	0	2
	About right	60	51
	Excessive	<u>3</u>	<u>2</u>
	Total	63	55

TABLE V
SUGGESTED RECIPE CHANGES

Menu	Item	Change
B-1	Oatmeal	Additional instructions as follows: If not served immediately after preparation, add sufficient hot water to maintain proper consistency.
B-5	Wheat Cereal	Same as for B-1.
B-6	Pancakes	Decrease water $\frac{1}{2}$ quart per module.
D-2	Chili	Increase rehydration time 15 minutes. Additional instructions as for B-1.
D-3	Strawberries	Decrease water 1 cup per module. Increase quantity of strawberries by 50 percent.
D-4	Hamburgers	Increase water for rehydration 1 quart per module.
	Peas & Carrots	Decrease water $\frac{1}{2}$ quart per module.
D-6	Green Beans	Decrease water $\frac{1}{2}$ quart per module.
	Sweet Potatoes	Same as for B-1
	Cookies	Drop cookies be produced since dusting flour for the rolling of cookies is not provided.
S-1	Pea Soup	Same as for B-1
S-2	Steaks	Increase water for rehydration 1 quart per module.
	Corn	Decrease water $\frac{1}{2}$ quart per module.
	Rice	Increase water $\frac{1}{2}$ quart per module.
S-4	Potato Soup	Same as for B-1
	Green Beans	Decrease water $\frac{1}{2}$ quart per module
S-5	Corn & Beans	Decrease water $\frac{1}{2}$ quart per module.
S-6	Beef Stew	The Menu Information and Schedule Sheet and the recipe to show the same type of water, i. e. hot or cold. A more desirable product was obtained when cold water was used in the initial step of Preparation.

beverages is 13-14 quarts per module for all menus except for supper menus 5 and 6. For these two menus, the water requirement for beverages is 7 quarts per module. All supper meals include soup which required 6-7 quarts of water per module; therefore, the water requirements for supper menus 1 through 4 are considerably greater than those for other menus.

On the basis of observations made during this test, there are no characteristics of the Meal, Uncooked, 25-Man which would make it different from the Standard "B" Ration with regard to the quantity of water required for cleanup operations after meals.

b. Preparation Time

Examination of Table III shows that the average preparation time for all menus during this test was greater than that shown on the Menu Information and Schedule Sheet. Preparation time included the time required for heating water. Menus requiring the greatest additional time for preparation were: Breakfast 2, Dinner 2, 5, 6, and Supper 2, 3, and 4. Five of these seven menus involved baked dessert items. The inadequacy of the field kitchen equipment (Par. 2.5) was a contributory factor to this additional preparation time; however, other factors such as the time required to heat water and the number of modules prepared also contributed to the additional time required for the preparation of the menus. In actual use, many factors must be considered in determining the preparation time for each menu. For example, the time required for heating water to the boiling point will vary with the quantity of water, the ambient temperature, and other environmental conditions. In the conduct of this subtest under ambient temperature conditions as shown in Appendix I-D, it was found that approximately 45 minutes of the total preparation time for each menu shown in Table III was required for heating water.

The time schedule as shown in the Menu Information and Schedule Sheet (Fig. 2), although a suggested schedule, is not realistic and is misleading to the user. Since the preparation time schedule can be affected by many conditions, some of which are uncontrollable, it is recommended that the time schedule be eliminated from the Menu Information and Schedule Sheet. The Unit Mess Steward would then establish a time schedule based on the specific preparation time for specific items, as shown in the recipe attached to each component package (unit package label - Fig. 2), the number of modules to be prepared, environmental conditions, and related factors.

On the basis of observations made during this test, there are no characteristics of the Meal, Uncooked, 25-Man which would make it different from the Standard "B" Ration with regard to serving and cleanup time.

c. Instructions, Ease of Preparation, and Recipes

Examination of Table IV (question 1) shows that approximately 92 and 98 percent of the skilled and unskilled cooks, respectively, responded that the instructions for preparing the meal as shown on the component packages were adequate and easy to follow. With regard to the ease of preparation, responses to question 2 of Table IV show that approximately 92 and 85 percent of the skilled and unskilled cooks, respectively, rated the meal as being in the "very easy" and "moderately easy" categories. Thus the majority of the cooks, both skilled and unskilled, experienced no major problems in preparing meals. While these findings were generally supported by observations of the test team, the overall quality of preparation of the meals by the unskilled cooks was not as good as that by the skilled cooks. Although the instructions for preparing the meals were considered to be reasonably adequate and easy to follow on the part of the unskilled cooks, problems were encountered by these individuals because they lacked experience in field mess operations including the use of the M-1937 Field Range. No general agreement was reached as to a specific skill level and the amount of training and experience required for cooks in the preparation of the meals; however, it was established that the use of skilled cooks with experience in field mess operations is considered essential to the proper preparation of the Meal, Uncooked, 25-Man in spite of the simplicity of instructions provided and the inherent ease of preparation of the menus.

Overall, the recipes were found to be reasonably accurate. Examination of Table V shows that, in general, the recommended changes pertained to variations in the quantity of water required for specific menu items. The preformulation and preportioning of components of the menus result in less complicated recipes than for other types of rations. It is noted that many items require the addition of water in order to maintain the proper consistency of a specific product if it is not served immediately after preparation. The term "cups", used as a unit of measurement in both the recipes and the size of servings of foods, should be deleted and all references to cups be converted and shown as dipper, ladle, or food service spoon, since these items are available for use with the M-1937 Field Range.

Responses to question 3, Table IV, show that the majority of the personnel felt that the size of serving for each food item as shown by the respective recipe was adequate except for strawberries (Dinner 3). The quantity of strawberries should be increased by 50 percent. Some problems were encountered in serving Pork Slices (Dinner 3), Vanilla Wafers (Supper 2), and Crackers (all supper menus) because the items were slightly broken during prior shipping and handling (Par. 2.6).

d. General

(1) A problem was experienced in the use of the margarine as a spread due to the effects of temperature on the consistency of the product. At 90°F., the margarine was soft making it difficult to serve in the conventional manner. When samples were held under controlled conditions at temperatures above 90°F. it was found that the product was extremely soft, some of the fat ingredients liquefied and seeped out of the wrapper, and the product could be served only with a spoon. When a 100cc sample of the margarine was held under controlled conditions at 104°F. for 48 hours, 75cc (75 percent) of the sample was in a liquid form with the other 25cc (25 percent) in a semisolid state. When subjected to a temperature of 40°F. for 48 hours, this sample of margarine remained separated, even though the product had solidified. Based on the above, the suitability of use as a spread of margarine which has been subjected to temperatures above 98°F. is marginal.

(2) Except for Supper 5 and 6, the quantity of beverages (coffee, tea, cocoa) for this ration is 13 gallons per 100 men. This is considered excessive, especially in hot weather. By comparison, the quantity of hot beverages for the Meal, Uncooked, 25-Man is 3 1/2 gallons per 100 men greater than for like items for the Standard "B" Ration (SB 10-495)². Regardless of the quantity of beverages to be authorized, variety is also important. For a greater variety, it is suggested that consideration be given to the inclusion in the ration of other types of dehydrated beverage bases such as orange, lemon, and grape.

(3) The chocolate chips for cookies (Supper 3) melted when a sample of the chips were held under controlled conditions at temperatures above 98°F.

²Standard "B" Ration for the Armed Forces.

(4) The feasibility of preparing bread rolls, utilizing standard field kitchen equipment and standard instant bread mix, was evaluated. It was determined that a satisfactory product can be obtained using procedures as shown in Appendix I-E. However, due to the time element involved and the overloading of equipment, the preparation of bread rolls in the field kitchen should be limited to emergency use only.

(5) There was evidence of leakage in some packages of jelly due to faulty seals, the rupture of the packaging at the wall-seal junction, and the extremely thin consistency of the product.

(6) Three packages of the breading mix for pork chops (Dinner 6) were found to be swollen.

(7) For greater variety, suggest the inclusion in appropriate menus of Lyonnaise Potatoes, O'Brien Potatoes, Potatoes au Gratin, and other method of preparation for which dehydrated ingredients are available.

(8) Insofar as possible, ingredients peculiar to a specific food item should be packaged with that item. For example, it was noted during this test that the peanut butter, an ingredient for the cake icing (Supper 5), was not packaged with the icing mix, but with the mushroom and gravy mix.

(9) It appears that shortening might be a more suitable ingredient for griddle frying purposes than margarine due to its capability to better withstand temperatures of 400 to 500°F.

2.4 DURABILITY AND RELIABILITY

2.4.1 Objectives

To determine:

a. Resistance of the cases and packages to water, insects, and rodents.

b. Ease of opening of cases and packages.

2.4.2 Method

Two cases of each menu (a total of 36 cases) were randomly selected and placed on the USAGETA's Rain Course for exposure to the

equivalent of 1-inch per hour rainfall. Eighteen cases were stacked on a pallet and covered with a tarpaulin while the other 18 cases were placed on another pallet without any covering. Two cases from each simulated storage condition were withdrawn at 30-minute intervals and the cases and contents examined for water penetration and damage. Exposure time ranged from a minimum of 30 minutes to a maximum of 4 1/2 hours.

Data pertaining to the ease of opening cases and packages were obtained through observation by test team personnel and interview of cooks during the preparation of meals as outlined in paragraph 2.3. Pertinent data as to the resistance of cases and packets to insects and rodents and to the long-term storage capabilities of the meal were obtained from the U.S. Army Natick Laboratories.

2.4.3 Results

There was no evidence of water penetration in any of the cases under the covered storage condition and consequently no damage to the contents of the cases was found. Shown in Appendix I-F are data pertaining to water penetration of cases and packages in the uncovered storage condition. Shown in paragraph 4, Appendix I-G, page I-G-2, is information obtained from Natick Laboratories with regard to water, insect, and rodent resistance of the cases and packages.

Some difficulty was encountered in opening the meal cases as wire cutters or other suitable equipment for cutting the wire banding material around the cases were not available with the M-1937 Field Range. The butcher's steel, a part of the M-1937 Field Range Accessory Outfit, was generally used to twist and break the wire bands. While this procedure accomplished desired results, it is a misuse of the butcher's steel and it could easily render the item useless for sharpening knives. Also, in some instances it was difficult to remove the inner case from the outer case since a telescoping-type of container was used and the inner case was too large for the outer case (Par. 2.2). No problems were encountered in opening the individual food component packages.

2.4.4 Analysis

Examination of Appendix I-F shows that there was water penetration of the outer (shipping) case of 16 of the 18 cases subjected to uncovered storage conditions. The water penetration in all instances was

through the end seals of the outer case. This was attributed to the end flaps not closing properly which resulted in openings up to 3/4 by 7 inches at the seals (Par. 2.2 and Fig. 2). On the contrary, there was water penetration of the inner case in only 3 of the 18 cases with no damage to major components since all components, except small items such as sugar, coffee, tea, whitener, and condiments, are overpacked in waterproof flexible packaging. In view of the dampness to sugar, coffee, whitener, and condiments in this test (App. I-F), it is apparent that the current packaging for these items does not provide maximum protection from water. In this connection, regardless of whether the dampness was due to the improper closure of the shipping case, these items should also be overpacked in waterproof flexible packaging. Information obtained from Natick Laboratories (Par. 4, App. I-G), page I-G-2 indicates that the cases and packages are resistant to water, insects, and rodents; however, with components in flexible packages rather than metal cans the packaging will not prevent penetration by boring-type insects. Further, while investigation is underway on the effectiveness of different treatments in preventing penetration by borers, the insect and rodent resistance of the test item are considered to be as good as the present state of the art permits. Based on the above, the Meal, Uncooked, 25-Man partially meets the requirements of the Military Characteristics as to the cases and packages being water, insect, and rodent resistant since the current prototype does not provide maximum protection against water.

The major problem encountered in opening packages was the lack of a suitable tool or device for cutting the wire banding material from the shipping cases. A suitable tool or device should be provided with the M-1937 Field Range Accessory Outfit (Par. 2.5) for this purpose. Overall, the Meal, Uncooked, 25-Man partially meets the requirements of the Military Characteristics in this connection since a suitable tool or device for cutting the wire bands was not available to the user.

2.5 ASSOCIATED EQUIPMENT

2.5.1 Objective

To determine the adequacy of the M-1937 Field Range and its accessory equipment in the preparation of the menus.

2.5.2 Method

During the preparation of menus as outlined in paragraph 2.3, participating food service personnel (cooks) completed questionnaires pertaining to the adequacy of the currently authorized equipment from the standpoint of design and quantity in the preparation of the menus. Further, observations were made and recorded by test team personnel in this connection.

2.5.3 Results

A total of 118 responses was received from food service personnel pertaining to the adequacy of the M-1937 Field Range and its accessory equipment in the preparation of the test item. Of this total, there were 95 responses indicating the equipment was adequate and 23 responses indicating it was not adequate.

2.5.4 Analysis

Approximately 80 percent of the responses shows that the currently authorized equipment was adequate from the standpoint of design and quantity. The "not adequate" responses, for the most part, pertained to the lack of a sufficient number of aluminum baking pans for use with those menus requiring a baked dessert item. Observations of the test team personnel confirmed the above. In this connection, there are 5 menus (D-2, -5, -6, S-3, and S-4) for which a baked dessert item is scheduled for preparation in the field kitchen. Also, in the preparation of cheese toast with bacon (B-2) some problems were encountered due to an insufficient number of aluminum baking pans. Bake pans (1 3/8 by 16 by 19 1/2 inches) are authorized at the rate of one pan per M-1937 Field Range or three pans for three ranges which is the allowance of ranges for units feeding from 101 to 225 men. Each bake pan will yield from 25 to 35 servings of cake, cobbler, or similar item for a total of 75 to 105 servings for three bake pans. In the field, the re-use of the bake pans for a given meal creates a problem due to the lack of equipment or facilities, other than bake pans for the storage of cakes and cobblers. Therefore, a unit feeding 225 men would have an insufficient number of aluminum baking pans for the preparation of some menus.

Additional aluminum baking pans must be made available for the proper preparation of menu items. Based on the results of this test, the current authorized allowance of one aluminum baking pan per range outfit

should be changed to three per range outfit. It is emphasized, however, that this increase in the number of aluminum baking pans authorized is required not only for the 25-Man Meal, but in the preparation of baked items for all types of rations normally used in the field. In addition to the need for more baking pans, efficient utilization of equipment will require that the field range be adapted by the user for baking as shown in paragraph 28, TM 10-701. If this is not accomplished, the individual baking pan will not only fail to fit inside of the range but must be placed inside the baking and roasting pan for the baking process. This results in the baking and roasting pan not being available for other purposes, if needed, during the baking of dessert items.

Overall, the standard field messing equipment is considered as only partially fulfilling the requirements with regard to adequacy of equipment in the preparation of the Meal, Uncooked, 25-Man since additional aluminum baking pans are needed and the Field Range must be adapted for baking.

2.6 TRANSPORTATION AND HANDLING

2.6.1 Objective

To determine the capability of the Meal, Uncooked, 25-Man to withstand military handling during transportation and storage prior to use.

2.6.2 Method

Forty cases of each of the 18 menus (720 cases) were shipped unpalletized by motor freight from the point of assembly (Kansas City, Missouri) to Fort Lee, Virginia, on 14 May 1965. The cases were off-loaded upon arrival at Fort Lee, Virginia, and stored under conditions normally used for nonperishable subsistence. During the performance subtest (Par. 2.3) the test item was loaded onto a military truck and transported a distance of approximately 3 miles to the field kitchens. Further, as part of a simulated transportation and handling exercise under field conditions, 396 cases (22 cases of each menu) were loaded onto two 5-ton cargo trucks and transported on 20 June 1966 to Camp Pickett, Virginia, a distance of approximately 40 miles. The cases were off-loaded at a simulated class I supply point, reloaded onto three

2 1/2-ton cargo trucks, and transported a distance of approximately 6 miles where they were unloaded and stored for 3 days. The cases were then loaded onto two 5-ton cargo trucks and returned to Fort Lee, Virginia, for off-loading and storage.

An initial examination of the test item was made upon receipt of the item from the point of assembly. During each subsequent storage, transporting, and handling phase to include the performance subtest (Par. 2.3), observations were made by test team personnel on the case markings and legibility of such markings, the durability of cases to include the capability of the cases and packages to withstand military handling during storage prior to use, and the suitability of the test item for transporting in standard military vehicles.

2.6.3 Results

All outer cases were properly marked to show essential data to include name of the ration, stock number, number of meals, menu number, weight, cube, and date of pack. The inner cases were marked to show the name of the ration and the menu identification. All markings remained legible under conditions subjected to in the storage, transport, and handling of the item. Some minor breakage was observed in the pork slices (Dinner 3), vanilla wafers (Supper 2), and crackers (all supper menus); however, no damage of any practical significance to the cases and packages or other foods were observed as a result of the transportation, storage, and handling of the items.

2.6.4 Analysis

Based on the above, the Meal, Uncooked, 25-Man satisfactorily meets the requirements with respect to marking of cases and packages, and its container system is highly satisfactory from the standpoint of transportation and handling.

2.7 NUTRITIONAL ADEQUACY

2.7.1 Objectives

To determine:

- a. If the Meal, Uncooked, 25-Man will provide the caloric and nutritional values required.

b. If consumption of the Meal, Uncooked, 25-Man over a period of a year as a sole diet will have any detrimental physiological effect on the soldier.

2.7.2 Method

Data pertaining to caloric and nutritional values, balance, physiological effects, and related factors were obtained from the U. S. Army Natick Laboratories and, through that organization, from the Office of The Surgeon General.

2.7.3 Results

Shown in paragraphs 1 and 3 of Appendix I-G, page I-G-2, are statements received from the U. S. Army Natick Laboratories which reflect their views and those of the Office of The Surgeon General as to nutritional adequacy, balance, and physiological effects. Paragraph 1 of Appendix I-G, page I-G-2, indicates that, with the required bakery supplementation, this ration meets the nutritional requirements as to quantity and balance, and meets or exceeds basic dietary standards set forth in Appendix V, AR 40-5³. Appropriate breakfast, dinner, and supper menus are provided. With respect to physiological effects, paragraph 3 of Appendix I-G, page I-G-2 indicates that evidence of compliance with the basic dietary standards of AR 40-5³, analytical studies, storage studies, and animal and human feeding studies with dehydrated foods indicate that the meal with bakery supplementation, will not have detrimental effects if used as the sole diet for extended periods. However, to confirm this before the meal is adopted for use as the sole diet over indefinite periods in excess of 30 days, further nutritional evaluations should be conducted in cooperation with the Office of The Surgeon General.

2.7.4 Analysis

Based on the above, the Meal, Uncooked, 25-Man meets the requirements of the Military and Technical Characteristics with respect to caloric and nutritional values and balance. Whether the Meal, Uncooked, 25-Man can be consumed over a period of a year as a sole diet without any detrimental physiological effects on the consumer was not determined. Further nutritional evaluations should be conducted before this ration is adopted as the replacement for the Standard "B" Ration.

³Replaces AR 40-564.

2.8 STORAGE STABILITY

2.8.1 Objectives

To determine that:

a. The ration is capable of storage without refrigeration for a minimum of 2 years (a longer period is desirable) without spoilage or detrimental decrease in nutritional value or palatability.

b. The ration can withstand transit and handling in temperatures ranging from -65° to +125°F. and shall be suitable for preparation in tents or other shelters during periods of extreme cold.

c. All food components, in the packaging used for the Meal, Uncooked, 25-Man, are capable of withstanding at least 6 months at 100°F. without significant loss of nutritional adequacy, edibility, acceptability, or rehydration characteristics where applicable, and they are capable of withstanding repeated freezing and thawing involving exposure, in the ration case, to temperatures as high as 125°F. for as long as 2 hours per day, and as low as minus 65°F. without significant loss of nutritional adequacy, acceptability, and utility.

2.8.2 Method

Pertinent data pertaining to these objectives were requested and received from U.S. Army Natick Laboratories.

2.8.3 Results

Shown in paragraphs 5 and 6, Appendix I-G, page I-G-2, are data received from U.S. Army Natick Laboratories pertaining to the effects of storage on the stability of the Meal, Uncooked, 25-Man. Paragraph 5, Appendix I-G, page I-G-2, indicates that, based on storage tests, the ration will withstand 2 years or more of unrefrigerated storage when components are properly manufactured and package integrity is maintained. Paragraph 6, Appendix I-G, page I-G-2 indicates that the ration will withstand exposure to the temperature extremes required by the Military and Technical Characteristics, and it is suitable for preparation in shelters under extreme cold. Further, it will withstand the storage and transit

conditions set forth in paragraph 7b, c, and d, change 1, AR 705-15. Paragraph 7a, AR 705-15, specifies temperature conditions different from those in the approved MC's and TC's for this ration. While this ration would more closely meet the requirements of paragraph 7a, AR 705-15 than rations composed of wet pack foods, it is unrealistic to expect any food, even when protected by the ration case and stack, to withstand a 4-hour exposure to 155°F. each day for an indefinite period without eventually becoming unfit for consumption.

2.8.4 Analysis

Based on the above, the Meal, Uncooked, 25-Man is considered to meet the storage stability requirements of the Military and Technical Characteristics.

2.9 CHEMICAL, BIOLOGICAL, AND RADIOLOGICAL PROTECTION

2.9.1 Objective

To determine if the cases and packages of the Meal, Uncooked, 25-Man provide CBR protection to the food components.

2.9.2 Method

Information pertaining to the adequacy of the cases and packages of the test item from the standpoint of CBR protection to the food components was obtained from the U. S. Army Natick Laboratories.

2.9.3 Results

Information obtained from U. S. Army Natick Laboratories (App. I-G) indicates that the cases and packages will provide adequate CBR protection to food components if package integrity is maintained. Contract research in progress has confirmed that the materials comprising the flexible packages, used for the individual food components, are the best available for protection against Chemical Warfare Agents. Past studies, as well as current investigation, have confirmed the capability of properly made flexible packages to prevent penetration by bacteria. Past studies have also shown protection from fallout. If the package is damaged, however, these protective characteristics will obviously be affected. Protection to the components are also provided by the fiberboard shipping case,

the intermediate fiberboard container, and the fiberboard overwrap on each individual food component. While the state of the art of flexible packaging has not yet reached the point that packs based on such unit packages afford protection equal to that given by packs based on hermetically sealed metal cans, attention is invited to the fact that the bulk packed Standard "B" Ration includes many components which are not packaged in metal cans.

2.9.4 Analysis

Based on the above, the cases and packages of Meal, Uncooked, 25-Man are considered satisfactorily to meet the requirements of the pertinent Military Characteristics.

2.10 VALUE ANALYSIS

2.10.1 Objective

To determine whether there are features in the design, materials, or general configuration of the Meal, Uncooked, 25-Man which were not essential to its proper performance.

2.10.2 Method

During the conduct of all subtests, observations were made to determine whether the Meal, Uncooked, 25-Man incorporated any features which could be eliminated without compromising its acceptability, utility, and general performance.

2.10.3 Results

Based on observations, the necessity of one feature incorporated in the ration is questionable. This involves the inclusion of crackers and vanilla wafers in the ration. Since minimum volume is of importance, both items require a sizeable amount of volume by comparison to the nutritive value that these items will provide. Also, the inherent fragility of these items, and the resultant breakage because of transportation and handling further indicate that the practicality of including these items in the ration is questionable.

2.10.4 Analysis

The overall value of including crackers and vanilla wafers in the Meal, Uncooked, 25-Man is questionable. It is doubtful that elimination of these items would significantly compromise its acceptability, utility, or general performance. No other unnecessary features were observed in the ration.

2.11 HUMAN FACTORS EVALUATION

2.11.1 Objective

To determine if the Meal, Uncooked, 25-Man, is designed in conformance with human factors engineering.

2.11.2 Method

During the conduct of all subtests, general observations were made to determine whether features or characteristics of the Meal, Uncooked, 25-Man were incompatible with human factors engineering.

2.11.3 Results

In spite of some difficulties encountered in opening cases (Par. 2.4), the data show that the overall design characteristics of the Meal, Uncooked, 25-Man provide man-materiel compatibility.

2.11.4 Analysis

The Meal, Uncooked, 25-Man is considered satisfactory from a human engineering standpoint.

SECTION 3. APPENDICES

APPENDIX I - TEST DATA

- A Weight and volume of menus exclusive of bread and cake
- B Weight of menus to include addition of bread and cake mixes
- C Volume of menus to include addition of bread and cake mixes
- D Weather data
- E Procedures for preparing bread rolls
- F Summary of water resistance of cases
- G Data obtained from Natick Laboratories

APPENDIX II - FINDINGS

APPENDIX III - DEFICIENCIES AND SHORTCOMINGS

APPENDIX IV - REFERENCES

APPENDIX V - DISTRIBUTION LIST

APPENDIX I. TEST DATA

APPENDIX I-A

WEIGHTS AND VOLUMES OF MENUS AS PACKAGED EXCLUSIVE OF BREAD AND CAKE MIXES

<u>MEAL</u>	<u>WEIGHT (Lbs.)</u>		<u>VOLUME (Cu. Ft.)</u>	
	<u>As Recorded On Case</u>	<u>Actual</u>	<u>As Recorded On Case</u>	<u>Actual</u>
B-1	17	17.9	0.6	0.71
B-2	16	16.7	0.7	0.77
B-3	16	16.4	0.6	0.68
B-4	16	15.6	0.5	0.62
B-5	17	17.1	0.5	0.63
B-6	18	18.4	0.5	0.63
D-1	15	15.4	0.5	0.63
D-2	21	21.3	0.8	0.96
D-3	16	16.1	0.7	0.77
D-4	15	14.6	0.6	0.71
D-5	21	21.4	0.7	0.82
D-6	19	18.9	0.7	0.87
S-1	22	22.4	0.8	0.97
S-2	24	24.3	1.1	1.28
S-3	21	21.0	0.8	0.96
S-4	22	22.2	0.8	0.97
S-5	19	19.4	0.8	0.96
S-6	20	19.9	0.7	0.86
AVERAGE	18.6	18.8	0.69	0.82

APPENDIX I-B

WEIGHT OF MENUS INCLUDE ADDITION OF BREAD AND CAKE MIXES

Menu No.	Actual Weight (lbs) W/O Bread & Cake	Weight (lbs.) with Bread Mix Only	Weight (lbs.) with Bread & Cake Mixes
B-1	17.9	21.4	21.4
B-2	16.7	20.2	20.2
B-3	16.4	19.9	19.9
B-4	15.6	19.1	19.1
B-5	17.1	20.6	20.6
B-6	18.4	21.9	21.9
D-1*	15.4	18.9	21.4
D-2	21.3	24.8	24.8
D-3*	16.1	19.6	22.1
D-4*	14.6	18.1	20.6
D-5	21.4	24.9	24.9
D-6	18.9	22.4	22.4
S-1	22.4	25.9	25.9
S-2	24.3	27.8	27.8
S-3	21.0	24.5	24.5
S-4	22.2	25.7	25.7
S-5*	19.4	22.9	25.4
S-6*	19.9	23.4	25.9
Avg.	18.8	22.3	23.0

*Requires cake.

APPENDIX I-C

VOLUME OF MENUS TO INCLUDE ADDITION OF BREAD AND CAKE MIXES

Menu No.	Actual Volume (cu. ft.) W/O Bread & Cake	Volume (cu. ft.) with Bread Mix	Volume (cu. ft.) with Bread and Cake Mixes
B-1	0.71	0.81	0.81
B-2	0.77	0.87	0.87
B-3	0.68	0.78	0.78
B-4	0.62	0.72	0.72
B-5	0.63	0.73	0.73
B-6	0.63	0.73	0.73
D-1*	0.63	0.73	0.80
D-2	0.96	1.06	1.06
D-3*	0.77	0.87	0.94
D-4*	0.71	0.81	0.88
D-5	0.82	0.92	0.92
D-6	0.87	0.97	0.97
S-1	0.97	1.07	1.07
S-2	1.28	1.38	1.38
S-3	0.96	1.06	1.06
S-4	0.97	1.07	1.07
S-5*	0.96	1.06	1.13
S-6*	0.86	0.96	1.03
Average	0.82	0.92	0.94

* Requires cake.

APPENDIX I-D

PERTINENT WEATHER DATA FOR DATES MEALS PREPARED

Date	Temperature (°F.)			Avg Rel Hum (%)	Precipitation (in)
	Max	Min	Avg		
25 June	71	64	67	79	.04
12 July	71	67	70	97	.19
13 July	86	67	76	81	0
14 July	91	67	79	77	0
21 July	82	60	71	67	0
22 July	84	53	71	69	0
26 July	89	73	80	77	.13
27 July	79	70	75	95	.36
28 July	83	68	75	89	0
4 August	88	58	76	74	0
23 August	91	70	79	84	.02
24 August	82	68	75	82	.22
19 October	70	58	63	85	0
20 October	77	58	65	81	0

APPENDIX I-E

PROCEDURES FOR PREPARING BREAD ROLLS
FROM INSTANT BREAD MIX AND USING M-1937 FIELD RANGE

Yield - 27 bread rolls (2 2/3 ounces each) which will provide sufficient bread requirements for each 25-man module.

Ingredients

- 54 ounces instant bread mix
- 28 ounces water (52 percent absorption)
- 2 ounces dusting flour (instant bread mix)

Procedures

1. Combine instant bread mix (54 ounces) and water (100°F.) and mix by hand from 4 to 5 minutes.
2. Roll dough into a long, round strip with a uniform diameter (2 to 2½ inches). Cut strip into 3-ounce pieces about 3½ to 4 inches in length. Place pieces one-half inch apart on greased baking pan and allow to rest for 5 minutes.
3. Bake in hot oven (high flame) from 25 to 35 minutes.

NOTE: Three batches can be mixed and baked (using 3 ranges) at one time. Total time per batch is 45 to 60 minutes.

APPENDIX I-F

SUMMARY OF WATER RESISTANCE OF CASES AND DAMAGE TO CONTENTS AFTER EXPOSURE TO 1-INCH RAINFALL FOR PERIODS UP TO 4½ HOURS UNDER UNCOVERED STORAGE CONDITIONS

Menu	Lapse Time (hrs)	Outer Case		Inner Case		Damage to Contents
		Leakage at seals	Water Penetration	Leakage At Seals	Water Penetration	
B-5	.5	Yes	Light	No	None	None
S-4	.5	No	None	No	None	None
B-6	1.0	Yes	Light	No	None	None
D-4	1.0	Yes	Light	No	None	None
B-2	1.5	Yes	Light	No	None	None
D-6	1.5	Yes	Light	No	None	None
S-6	2.0	Yes	Light	No	None	None
D-5	2.0	Yes	Light	No	None	None
B-1	2.5	Yes	Heavy	Yes	Heavy	Sugar & Coffee Damp
D-2	2.5	Yes	Light	No	None	None
S-3	3.0	No	None	No	None	None
D-3	3.0	Yes	Light	No	None	None
S-2	3.5	Yes	Light	No	None	None
S-5	3.5	Yes	Heavy	Yes	Heavy	None *
B-4	4.0	Yes	Light	No	None	None
D-1	4.0	Yes	Heavy	No	None	None
B-3	4.5	Yes	Heavy	No	None	None
S-1	4.5	Yes	Heavy	Yes	Heavy	Pepper, salt, coffee, and whitener damp

*Casing around potatoes was wet.

APPENDIX I-G

U. S. ARMY NATICK LABORATORIES

NATICK, MASSACHUSETTS

01760

IN REPLY REFER TO

AMXRE:FTP

17 FEB 1965

SUBJECT: Engineering/Service Test of Meal, Uncooked, 25-Man

TO: Commanding General
U. S. Army General Equipment Test Activity
Fort Lee, Virginia 23801

1. References:

a. Letter dated 2 April 1965, subject as above, STEGE-ET, requesting information on the extent to which subject meal meets specific military and technical characteristics and requesting concurrence of The Surgeon General in certain of these statements.


b. Letter dated 28 May 1965, subject: Meal, Uncooked, 25-Man, AMXRE-FPC (Inclosure 1) with five inclosures, containing NLABS statements on paragraphs 8a, b, and c of the Military Characteristics and paragraph 2a of the Technical Characteristics.

c. 1st Indorsement dated 21 June 1965 to reference 1b, MEDPS-PM (28 May 1965) (Inclosure 1). This indorsement, which also comments on Plan of Test for Engineering/Service Test of subject meal, essentially concurs in the statements of reference 1b, but points out that: (1) in view of the limited variety offered by the 18 menus under test, the meal will present problems of monotony and acceptability if used more than 30 days, (2) confirmation should be obtained that subsistence on this meal for periods longer than 30 days will have no detrimental physiological effects before it is adopted as a complete replacement for the B Ration, and (3) any research testing towards this end, involving periods in excess of 30 days, should be conducted with qualified members from the U. S. Army Medical Research and Nutrition Laboratory as members of the testing team.

2. Inclosure 2 is furnished in response to reference 1a. Statements therein reflect comments of reference 1c.

FOR THE COMMANDER:

2 Incls. (in dupe)
as


GERALD C. MACDONALD
Chief
Quality Assurance Office

MEAL, UNCOOKED, 25-MAN

1. Quantitative adequacy and balance (paragraphs 8a and 8b, MC, and 2a, TC): With the required bakery supplementation, this ration meets nutritional requirements as to quantity and balance, and meets or exceeds basic dietary standards set forth in Appendix V, AR 40-5. Appropriate breakfast, dinner, and supper menus are provided.
2. Variety and acceptability (paragraphs 8b, MC, and 2b, TC): As presently developed, there are menus for only six days (18 meals). Twelve additional menus are considered necessary to provide sufficient variety to avoid rejection because of repeated consumption when this ration is used as the sole diet, with bakery supplementation, over indefinite periods in excess of 30 days. Developmental plans call for a 10-day cycle (30 meals) before this meal can completely replace the B Ration for indefinite use. The present 18 meals are considered sufficiently acceptable to replace the B Ration for periods up to 30 days.
3. Physiological effects (paragraphs 8c, MC, and 2a, TC): Evidence of compliance with the basic dietary standards of AR 40-5, analytical studies, storage studies, and animal and human feeding studies with dehydrated foods indicate that the meal will not have detrimental effects if used as the sole diet, with bakery supplementation, for extended periods. Further nutritional evaluation should be conducted, in cooperation with the U. S. Army Medical Research and Nutrition Laboratory, to confirm this before the meal is adopted for use as the sole diet over indefinite periods in excess of 30 days, as a complete replacement for the B Ration.
4. Protectiveness of cases and packages (paragraph 9a, MC): The pack is water, insect, and rodent resistant, but, with components in flexible packages rather than metal cans, will not prevent penetration by boring types of insects or large gnawing rats. Investigation is underway on the effectiveness of different treatments in preventing penetration by borers. Insect and rodent resistance are considered as good as the present state of the art permits.
5. Storage life without refrigeration (paragraph 9e, MC): Storage tests indicate that the meal will withstand two years or more of unrefrigerated storage when components are properly manufactured and package integrity is maintained.
6. Environmental and terrain requirements (paragraphs 12a and b, MC, and 2c, TC): This item will withstand exposure to the temperature extremes indicated in the MC and TC and is suitable for preparation in shelters under extreme cold. It will also withstand the storage and transit conditions set forth in subparagraphs b, c, and d, paragraph 7, Change 1, AR 705-15. Attention is invited to the fact, however, that the temperature conditions of subparagraphs a and c, paragraph 7, are different from those established specifically for subject item by the DA approved MC's and TC's. Although this item is likelier to meet the requirements of subparagraph a than are rations based on wet pack foods, it is unrealistic to expect any food, even when protected by the ration case and stack, to withstand four hours' exposure to 155°F. every day for an indefinite period without eventually becoming unfit for consumption. As reference to AR 31-60 will show, nothing comparable to such resistance is required of any ration or food item currently in the Army supply system.

APPENDIX I-G

U.S. ARMY NATICK LABORATORIES
NATICK, MASSACHUSETTS 01760

IN REPLY REFER TO

AMKRE-FPC

27 JUN 1966

SUBJECT: Engineering/Service Test of Meal, Uncooked, 25-Man

TO: Commanding General
U. S. Army General Equipment Test Activity
ATTN: STEGE-ET
Fort Lee, Virginia 23801

1. Reference is made to telephone request from your Headquarters
27 June 1966.

2. The following information concerning paragraph 25 of the Military Characteristics for subject item is furnished in response to the foregoing reference. Available data indicate that adequate CBR protection will be furnished to food components where package integrity is maintained. Contract research in progress has confirmed that the materials comprising the flexible packages are the best available for protection against CW agents. Past studies, as well as current investigation under a no-cost agreement with an industrial laboratory, have confirmed the capability of properly made flexible packages to prevent penetration by bacteria. Past studies have also shown protection from fallout. If the package is damaged, however, these protective characteristics will obviously be affected. The fiberboard shipping case used is made in accordance with style RSC, class weather resistant, grade V2s of PPP-B-636. Components receive additional protection from an intermediate fiberboard container which is to comply with style RSC, CF or SF, weather resistant, grade W5c or W5s of PPP-B-636. While the state of the art of flexible packaging has not yet reached the point that packs based on such unit packages afford protection equal to that given by packs based on hermetically sealed metal cans, attention is invited to the fact that the standard, bulk packed, B Ration includes many components which are not packaged in metal cans. On an overall basis, therefore, subject item is believed to comply with the requirements of this military characteristic.

FOR THE COMMANDER:


GERALD C. MacDONALD

Quality Assurance Office

APPENDIX II. TEST FINDINGS

Key
MC-----Military Characteristics
TC-----Technical Characteristics

Requirements	Findings
1. MC 7a: Shall be packaged as a meal for 25 men exclusive of breads and cakes which will be provided separately.	Requirement met (Par. 2.2).
2. MC 7b: Each packaged meal shall be of minimum weight and bulk consistent with other requirements. Gross weight will not exceed 25 pounds.	Requirement met (Par. 2.2).
3. MC 8a: Shall, when supplemented with fresh bread and cake components, provide adequate quantity of food for 25 men for one meal. Appropriate breakfast, dinner, and supper menus will be provided.	Requirement met with regard to adequate quantity (servings) of food for 25 men for one meal except for strawberries (Dinner 3) which were inadequate (Par. 2.3). Appropriate breakfast, dinner, and supper menus were provided.
4. MC 8b: Shall be well balanced and provided in sufficient variety to be acceptable to troops for consumption over an extended period under all climatic conditions.	Based on statements received from Natick Laboratories which reflect views of the Office of The Surgeon General, the ration meets requirement with regard to balance (Par. 2.7). Extent to which ration meets requirements pertaining to variety and acceptability were not determined (Par. 2.1).
5. MC 8c: Shall have no detrimental physiological effects when consumed over a period of a year as a sole diet with the bread and cakes which are provided separately.	Not determined; further evaluations must be conducted in this connection (Par. 2.7).
6. MC 8d: Shall require no refrigeration.	Requirement met (Par. 2.8).
7. MC 8e: Shall be simple to prepare by food service personnel who have received minimum training.	Requirement met (Par. 2.3).

APPENDIX II

Requirements	Findings
8. MC 9a: Cases and packages shall be water, insect, and rodent resistant.	Requirement partially met. Correction of improper closure of shipping cases and packaging of all items not now in water proof packaging would improve water resistance of cases and packages (Par.2.4).
9. MC 9b: Cases and packages shall be marked, and markings shall remain legible under all conditions encountered in storage, transport, and distribution.	Requirement met (Par. 2.6).
10. MC 9c: Cases and packages shall be capable of withstanding military handling during transportation and storage prior to use.	Requirement met (Par. 2.6).
11. MC 9d: Cases and packages shall be easily opened.	Requirement partially met. A suitable tool or device for cutting of wire bands around shipping case should be provided (Par.2.4).
12. MC 9e: This ration shall be capable of storage without refrigeration for a minimum of 2 years (a longer period is desirable) without spoilage or detrimental decrease in nutritional value or palatability.	Requirement met based on statements received from Natick Laboratories (Par. 2.8).
13. MC 10: Cases in which the rations are packed shall be capable of being transported in standard military vehicles, aircraft and vessels, and shall be capable of being aerial delivered by parachute.	Requirement met as pertains to transportation in standard military vehicles (Par. 2.6).
14. MC 11: Associated equipment -- Kitchen facilities.	Requirement partially met. Additional aluminum baking pans should be provided and the Field Range adapted for baking (Par.2.5).
15. MC 12a: Shall withstand transit and handling in temperatures ranging from -65°F. to +125°F. and shall be suitable for preparation in tents or other shelter during periods of extreme cold.	Requirement met based on statements received from Natick Laboratories (Par.2.8).

APPENDIX II

Requirements	Findings
16. MC 12b: Safe storage temperatures shall conform to AR 705-15 as amended.	Requirement met based on statements received from Natick Laboratories (Par. 2.8).
17. MC 25: Cases and packages shall be at least as resistant to CBR and atomic effects as current standard items.	Requirement met based on statements received from Natick Laboratories (Par. 2.9).
18. TC 2a: Breakfast, dinner, and supper meals will be designed so that any three meals, when supplemented by bread and cakes separately provided, furnish the daily nutritional requirements set forth in AR 40-564 (including 3600 calories per man) for 25 men, and any one meal, when supplemented by bread and cakes separately provided, furnishes 1/3 of the daily nutritional requirements (including 1200 calories per man) for 25 men.	Requirement met based on statements received from Natick Laboratories (Par. 2.7).
19. TC 2b: Acceptability: Menus for at least 10 days (3C meals) of 25-Man Uncooked Meals will be designed. Food components will be developed in terms of maximum acceptability and variety to avoid rejection because of repeated consumption. Human engineering principles will be applied throughout development of food components.	Not determined (Par. 2.1). In this connection, it is pointed out that current prototype consists of 18 menus (6 menus each breakfast, dinner, and supper) for use on a 6-day cycle whereas developmental plans call for 30 menus for use on a 10-day cycle.
20. TC 2c: Stability: All food components, in the packaging used for 25-Man Uncooked Meals, will be capable of withstanding at least six months at 100°F. without significant loss of nutritional adequacy, edibility, acceptability or rehydration characteristics where applicable, and will be capable of withstanding repeated freezing and thawing involving exposure, in the ration case, to temperatures as high as 125°F. for as long as two hours per day, and as low as minus 65°F. without significant loss of nutritional adequacy, acceptability, and utility.	Requirement met based on statements received from Natick Laboratories (Par. 2.8).

APPENDIX II

Requirements	Findings
<p>21. TC 2d: Utility: Unitization will reduce the number of line items requiring separate handling in the supply system, while pre-formulation and portioning will reduce the skill and training required for food preparation. Simple instructions will be provided. The gross weight of each case containing meals for 25 men, exclusive of bread and cakes, will not exceed 25 pounds.</p>	<p>Requirements met.</p>
<p>22. TC 3: Components: The Meal, Uncooked, 25-Man, will consist of breakfast, dinner, and supper meals containing all food needed for hot meals for 25 men except bread, cakes, and water. The food components will be processed by whatever methods prove most successful in meeting the military characteristics; maximum use will be made of dehydrated components and components processed by novel or improved thermal or combination methods. When the state of the art permits, radiation processed components will be included. Lightweight packaging will be used. Bakery supplements will be provided.</p>	<p>Requirement met.</p>

APPENDIX III. DEFICIENCIES AND SHORTCOMINGS

1. DEFICIENCIES

Deficiency

Suggested Corrective Action

Remarks

1.1 None

None

None

2. SHORTCOMINGS

Shortcoming

Suggested Corrective Action

Remarks

2.1 Preparation time schedule shown in the Menu Information and Schedule Sheet, although a suggested schedule, is not realistic and is misleading to the user (Par. 2.3.4 and Table III).

Delete time schedule from the Menu Information and Schedule Sheet, and leave the overall preparation time to the judgment of the user based on the recipes, number of modules to be prepared, environmental conditions, and related factors.

None

2.2 The quantity of strawberries was insufficient for adequate servings (Par. 2.3.4).

Increase the quantity of strawberries by 50 percent.

None

2.3 The recipes were inaccurate (Par.2.3.4 and Table V).

Modify recipes to incorporate suggested changes.

None

2.4 Margarine melts at temperatures above +98°F. and is only marginally suitable as a spread under these conditions (Par. 2.3.4).

Corrective action cannot be determined.

None

2.5 Chocolate chips for cookies melt at temperatures above +98°F. (Par. 2.3.4).

Corrective action cannot be determined.

None

2.6 Leakage of the jelly at the seals and wall-seal function of the packages and the consistency of the product is too thin(Par.2.3.4).

Corrective action cannot be determined.

None

APPENDIX III

None

Correct improper packaging and provide suitable tool or device in the authorized field equipment for the cutting of wire banding material.

None

Overwrap coffee, sugar, cream, and condiments in waterproof packaging materials and correct the improper closure of the flaps of the shipping case.

None

Take necessary steps for appropriate changes to authorized allowances of field mess equipment.

3. CORRECTED DEFICIENCIES AND SHORTCOMINGS

Remarks

None

Corrective Action

None

Deficiency/Shortcoming

3.1 None

48 2.7 Meal cases difficult to open (Par. 2.4.4).

2.8 Packaging does not provide maximum protection against water penetration (Par. 2.4.4).

2.9 Currently authorized field kitchen equipment inadequate for the preparation of 6 of the 18 menus (Par. 2.5.4).

APPENDIX IV, REFERENCES

1. WEEKS, ELIE, An Engineering Test Report of the Temperate Phase of the Consolidated Engineer/Service Test of the 6-Man and 25-Man Modules of the Experimental Quick-Serve Meal, Technical Report T-211, FEA 61023, December 1961, U.S. Army QMR&E Field Evaluation Agency, Fort Lee, Virginia.
2. BURT, THOMAS B., An Engineering Test Report of the Arctic Phase of the Consolidated Engineer/Service Test of the 6-Man and 25-Man Modules of the Experimental Quick-Serve Meal, Technical Report 62010, April 1962, U.S. Army QMR&E Field Evaluation Agency, Fort Lee, Virginia.
3. BURT, THOMAS B., Final Report of Engineering Test of Meal, Ready-to-Eat, Individual, USATECOM Project No. 8-3-7400-04, May 1964, U.S. Army QMR&E Field Evaluation Agency, Fort Lee, Virginia.
4. BURT, THOMAS B., Engineering Test of Meal, Uncooked, 25-Man, Prototype, Report of USATECOM Project No. 7-3-0171-01K, September 1963, U.S. Army Quartermaster R & E Field Evaluation Agency, Fort Lee, Virginia.
5. Letter, AMXRE-FPC, U.S. Army Natick Laboratories, 5 February 1965, subject: "Engineering/Service Test of Meal, Uncooked, 25-Man."
6. Letter, AMSTE-GE, Headquarters, USATECOM, 17 February 1965, subject: "Test Directive, USATECOM Project No. 7-3-0171-02, Engineering/Service Test of Meal, Uncooked, 25-Man, DA Project No. 1M643303D548."
7. Plan of Test for Engineering/Service Test of Meal, Uncooked, 25-Man, April 1965, U.S. Army General Equipment Test Activity, Fort Lee, Virginia.
8. Military and Technical Characteristics for Meal, Uncooked, 25-Man.
9. U.S. Army Combat Development Objective Guide, Paragraph 1439F(14).